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| (54) Title: METHOD FOR THE PREPARATION OF A PARTICULATE CARRIER FOR A POLYMERIZATION CATALYST (57) Abstract <p>The invention relates to a method for preparing a particulate carrier for an olefin polymerization procatalyst comprising a transition metal compound reacted for a carrier. In the method a melt $\text{MgCl}_2\text{-CH}_3\text{OH}$-complex is provided containing in the average 3.3 to 5.5 $\text{C}_2\text{H}_5\text{OH}$-molecules as per each MgCl_2-molecule, the melt MgCl_2-complex is sprayed through a nozzle dispersing it into a chamber, wherein a particulate carrier is formed of it and the ready particulate carrier is removed from the chamber. In the methods known so far difficulties have been encountered in endeavours to produce a carrier having an optimal $\text{C}_2\text{H}_5\text{OH}$ content. In this invention the problems have been solved by removing by the aid of heat so much $\text{C}_2\text{H}_5\text{OH}$ from the $\text{MgCl}_2\text{-CH}_3\text{OH}$-complex in connection with the spraying that the particulate carrier obtained will continue at the average 2.0 to 3.2 $\text{C}_2\text{H}_5\text{OH}$ molecules as per each MgCl_2 molecule. Such a carrier has a suitable $\text{C}_2\text{H}_5\text{OH}$ content and a good morphology and spraying it does not raise any difficulties.</p> | | |

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Method for the preparation of a particulate carrier for a polymerization catalyst

The invention relates to a method for preparing a particulate carrier for an olefin polymerization procatalyst comprising a transition metal compound reacted for a carrier, in which method

a) a melt $\text{MgCl}_2\text{-CH}_5\text{OH}$ -complex is provided containing in the average 3.3 to 5.0 $\text{C}_2\text{H}_5\text{OH}$ -molecules as per each MgCl_2 -

molecule

b) the melt MgCl_2 -complex is sprayed through a nozzle dispersing it into a chamber, wherein a particulate carrier is formed of it and

c) the particulate carrier is removed from the chamber.

For the polymerization of olefins the Ziegler-Natta-catalyst system is generally used, which consists of a so-called procatalyst and a cocatalyst. The procatalyst is based on a compound of a transition metal belonging to any of the groups IV(A) to VIII(A) (Hubbard) of the periodical system of elements and the cocatalyst is based on an organometallic compound of a metal belonging to any of the groups I(A) to III(A) (Hubbard) of the periodical system of elements.

Nowadays, the procatalysts typically comprise an inert carrier, on which the actual active catalyst component i.e. the transition metal compound or the mixture of the complex formed by the catalytical compounds has been layered. The morphology and size distribution of the particles of such a carrier are most significant for the activity of the catalyst and the properties of the polymer obtained through the catalyst. With an active catalyst you are, namely, able to produce a polymer, from which, due to its purity, no catalyst residues need to be removed. The morphology of the carrier, again, influences the morphology of the polymer product itself for it has been noticed that the morphology of the catalyst is repeated in the structure of the polymer (the so-called replica phenomenon). When a flowing product polymer having the desired morphology and a narrow

particular size distribution is wanted, which is desirable in view of the many aims of use of the processing processes, the properties of the carrier shall by the aid of the replica phenomenon be made similar.

5 Nowadays, the Ziegler-Natta type procatalysts typically comprise a magnesium based carrier, such as magnesium chloride, which has been treated with a transition metal compound of titanium halide, such as titanium tetrachloride, and sometimes also with an electron donor compound. It is
10 also known that the carrier can be brought to an advantageous and equal-size crystal form by letting it crystallize as a complex from any of its crystal solvents.

15 The treatment of such a carrier with a crystal solvent has been disclosed among others in the US patent specification 4,071,674, in which the procatalyst based on a transition metal compound has been prepared by bringing a titanium or vanadium compound to react with a reaction product that has
20 been formed when magnesium dihalide and the addition product of alcohol are reacting with an organometallic compound of a metal of any of the groups I-III. The preparation of the procatalyst begins with the addition of alcohol dropwise to the suspension of magnesium dihalide, after which the
25 organometallic compound is added dropwise to the the reaction mixture. After agitation the preactivated carrier is activated by adding titanium tetrachloride to the mixture. The adding stages of this kind of a method are primitive and do not at all allow regulation of the
30 morphology of the procatalyst in the way desired.

Treatment with a crystal solvent has also been described in the patent application JP-59-215301. In this publication the carrier complex (10g of $MgCl_2$ and 24.2g of EtOH) have been
35 prepared by emulsifying technique. The carrier complex melt has been dispersed into n-decane as spheroidal melt particles. Thereafter the carrier particles in the emulsion have been shock coagulated by transferring the emulsion into cold hydrocarbon medium. A drawback of this method is, among

others, that such components are needed in the preparation of the carrier that are not useful at later stages of the catalyst preparation and this presupposes the existence of a purifying and recirculation equipment for this purpose.

5 The patent family comprising, among others, the EP publication 65700 and the US publication 4,421,674 which claims priority from the Italian application IT 2,188,181 (810521), deal with a method for the preparation of a catalyst, which is particularly active in the polymerization of gaseous ethylene.

15 In the process titanium halide is brought to react with a magnesium chloride catalyst carrier being in the form of microballs, after which the reaction product particles are recovered by physical means and are mixed together with an organometallic cocatalyst product.

20 Characterizing of this method representing the prior art is that:

a) a solution is provided which contains essentially magnesium dichloride dissolved in ethanol, the concentration of which is between 100 to 300g of magnesium dichloride/l of solution, whereby the aqueous content of the solution does not exceed 5% by weight,

25 b) a spray-drying of the solution is carried out by spraying it to a flow of essentially non-aqueous nitrogen gas, the purity of which is at least 99.9% and the inflow temperature of which flow is between 180 to 280°C, whereby the flow and nitrogen and the solution are simultaneously controlled so that the outflow temperature is between 130 to 210°C, provided the outflow temperature mentioned is at least 40°C lower than the inflow temperature and ethanol does not evaporate completely, whereby spheroidal magnesium chloride particles are obtained,

35 c) the magnesium dichloride particles are brought to react with titanium halide, which is in vaporous or liquid form and is possibly diluted with an inert evaporizable solvent,

d) the reaction product particles are recovered by physical means, when they contain 0.7 to 12% by weight of titanium bound in solid material and

e) the reaction product particles mentioned are mixed with the organometallic compound, which is either alkyl aluminum or alkyl aluminum halide.

According to FI patent publication 80055 (Neste Oy) the above-mentioned carrier complex formed by the carrier and the crystal solvent can be melted to clear liquid. When this kind of a liquid is conducted through the spray nozzle to the spray space cooled with cold nitrogen gas it crystallizes to spheroidal small particles of the carrier complex which are very flowable and loose. The process took in practice place so that MgCl_2 and $\text{C}_2\text{H}_5\text{OH}$ were melted at the temperature 110 to 130°C to a clear melt. Then the clear homogenized mixture was fed through a nozzle dispersing it into a cooled spray chamber. The spraying gas used in the spraying was dry nitrogen having the temperature +130°C and as cooling medium dry nitrogen was conducted to the spraying chamber, the temperature of which was 20°C. As the nozzle a gas fluidizing nozzle was used.

This kind of a method produces very flowable and loose particles. Moreover, the carrier complex crystallizes without any evaporation of the crystal solvent. When such a carrier is brought into contact with titanium compound, abundantly of catalytically active complexes between MgCl_2 and the titanium compound are formed on the surface of the carrier when the crystal solvent leaves.

Accordingly, two methods of preparation based on the spraying are prior known in the field. The spray drying method patents are based on a fairly complete drying of the carrier liquid from ethanol ($\text{C}_2\text{H}_5\text{OH}$) after the spraying. Hereby, the carrier has usually been dried at a temperature exceeding 150°C, whereby a major portion of the alcohol of the complex is evaporated. In the spray-drying method a carrier product is typically obtained, the alcohol

concentration of which is between 15 to 25% by weight and anyway below 30% by weight.

One central drawback of spray-drying is the bad morphology of the carrier obtained and the wide particle size distribution, which is caused by the breaking of the particles during the process. In figures 1 and 2 an electron microscope picture of the carrier is presented. The close-up picture of figure 2 shows that the spheroidal particles are either compressed or then they have been broken into crust fragments of the hollow ball. On the basis of the physical process and the particles created in it, it can be supposed that the removal of C_2H_5OH at temperatures exceeding $+150^{\circ}C$ results in the formation of a gas state inside the particles, which then results in the disintegration of the spheroidal particles into crust fragments or their becoming compressed when the gas cools down in the hollow space. The spray-drying will, anyhow, result in a very poor carrier morphology.

It can thus be said that the spraying of the spray-drying is easy to carry out and the yield of the carrier is good. The activity of the procatalyst obtained by activation with $TiCl_4$ when polymerizing polypropylene is between 10 to 12kg of PP/g of catalyst and the morphology of the polymer obtained by it is very poor producing even 60 to 70% by weight of finely-divided material ($d < 1mm$), the bulk density being of the order of about 0.2g/ml. Be it mentioned that the above-mentioned activity of the procatalyst obtained by spray-drying is lower than that of the procatalysts obtained by other methods, which is due to the fact that in spray-drying the major portion of the C_2H_5OH participating in the $TiCl_4$ activation leaves the carrier before it is reacted with $TiCl_4$.

The spray-crystallization of such a melt $MgCl_2-C_2H_5OH$ complex that contains in the average 3.5 or more C_2H_5OH molecules as per each $MgCl_2$ molecule is easy and gives a relatively good yield, whereby the result is a procatalyst having a good

activity i.e. of the order of about 15kg of PP/g of catalyst. It has, however, been noticed that the C_2H_5OH amount of the carrier is the same as the respective amount of the melt and too high causing during the $TiCl_4$ activation heavy formation of HCl gas, which breaks the procatalyst particles and results in a poor procatalyst morphology and a poor particle size distribution. In the polymerization of polypropylene having a poor morphology and about 25 to 55% by weight of finely-divided substance ($d < 1mm$) is obtained. The bulk density of the polymer obtained is 0.40 to 0.44g/ml.

In the spray-crystallization of melt $MgCl_2-C_2H_5OH$ complex which contains less i.e. in the average about 2.9 molecules of C_2H_5OH as per each $MgCl_2$ molecule, big difficulties are again encountered when spraying melt into the crystallization chamber. Melt with little alcohol apparently is too viscous and causes clogging of the nozzle and formation of too big particles e.g. as a result of solidification. The carrier yield is very low remaining below 10%. In the polymerization of propylene a good activity of the procatalyst is obtained i.e. about 15kg of PP/g of catalyst, but the morphology of the polypropylene is poor and it contains 20 to 40% of finely-divided material ($d < 1mm$), the bulk density being between 0.40 to 0.44.

Accordingly, it seems that the spray-crystallization results in a procatalyst, the activity of which is medium and the polymer products of which contain a very great portion of finely-divided material, whereas the spray-crystallization results in a procatalyst having a good activity, but the polymer morphology of which is poor.

The aim of the present invention is to provide a new method for preparing a particulate carrier for olefin polymerization, which is easily sprayable and which gives with a fairly good yield material having a good morphology. The activity of the procatalyst must be as great as possible and the olefin polymerized by it must have a good morphology

and a possibly small portion of finely-divided material. Moreover, the other properties of the polymer, such as the built density and the melt index, must be satisfactory.

5 The above-mentioned aims have now been reached by a new kind of method for preparing a carrier for an olefin polymerization catalyst, which is principally characterized by what is mentioned in the characterizing clause of claim 1. It has thus been realized that a particulate carrier containing a suitable amount of C_2H_5OH is without difficulties obtained by a method in which

10 a) a melt $MgCl_2-CH_5OH$ -complex is provided containing in the average 3.3 to 5.5 C_2H_5OH -molecules as per each $MgCl_2$ -molecule

15 b) the melt $MgCl_2$ -complex is sprayed through a nozzle dispersing it into a chamber, wherein a particulate carrier is formed of it, and

20 c) the particulate carrier is removed from the chamber, so that during the stage b) so much C_2H_5OH is removed from the $MgCl_2-CH_5OH$ -complex by heat that the particulate procatalyst obtained will contain in the average 1.0 to 3.2 C_2H_5OH molecules as per each $MgCl_2$ molecule.

25 Accordingly, the invention is based on the idea that the drawbacks of the spray-crystallization can be overcome by carrying out a controlled C_2H_5OH removal stage for the mist of sprayed complex melt, which simultaneously allows an ideal melt viscosity in the spraying and an optimal C_2H_5OH content in the particulate carrier product to be produced.

30 In the method according to the invention it is preferable to produce at stage a) a melt containing in the average 3.5 to 4.0 and particularly about 3.7 C_2H_5OH molecules as per each $MgCl_2$ molecule.

35 According to one preferred embodiment of the invention the melt $MgCl_2-C_2H_5OH$ complex is sprayed into the upper portion of the chamber, where it is kept in a temperature removing C_2H_5OH and is then conducted into the lower portion of the

chamber, where it is cooled down in order to solidify the complex melt containing less C_2H_5OH into a particulate carrier. The melt $MgCl_2-C_2H_5OH$ complex can hereby be maintained at a temperature removing C_2H_5OH by spraying it into the upper portion of the chamber heated essentially above its melting point and/or by maintaining in the upper portion of the chamber a higher temperature than in the lower space of the chamber.

C_2H_5OH is removed substantially when $MgCl_2-C_2H_5OH$ complex is sprayed into the upper portion of the chamber preferably heated to a temperature of about $+120$ to $+250^\circ C$ and most preferably to a temperature of about 120 to $180^\circ C$. The use of this temperature range in the invention takes place so that the higher temperatures do not presuppose heating of the upper portion of the chamber but, when the higher temperatures are concerned, sooner cooling down of it, whereas the lower temperatures necessitate some kind of heating of the upper portion of the chamber for the removal of the C_2H_5OH from the complex. The temperature of the melt complex is, of course, also dependent on the basic C_2H_5OH content of the complex for the removal of greater amounts of C_2H_5OH from the complex naturally necessitates more heat.

According to one preferred embodiment of the invention the temperature of $+20$ to $+150^\circ C$, preferably the temperature $+30$ to $+80^\circ C$, dependent naturally on the composition of the complex and the temperature of the melt, is maintained in the upper portion of the chamber and in the lower portion of the chamber the temperature -30 to $+40^\circ C$ is preferably maintained and most preferably the temperature -20 to $+40^\circ C$, whereby the temperature of the lower portion is simultaneously kept lower than the temperature of the upper portion.

As the removal of C_2H_5OH from the complex is dependent on both the feeding temperature of the complex melt and the temperature of the receiving upper portion of the chamber, the process can be characterized as the ratio of these

temperatures so that it is advantageous to spray the MgCl_2 - $\text{C}_2\text{H}_5\text{OH}$ complex into the upper portion of the chamber heated to a temperature exceeding the melting point of the complex and being higher than (+130°C to the temperature of the upper portion of the chamber).

Inert nitrogen gas can, for example, be used for spraying melt and regulating the temperature of the chamber. The MgCl_2 - $\text{C}_2\text{H}_5\text{OH}$ complex can, thus, be sprayed into the chamber by the aid of a hot nitrogen flow. The temperature of the nitrogen flow is typically +130 to +150°C. Also the temperatures of the upper and lower portions of the chamber can be maintained by the aid of one or several nitrogen flows. The removal of the nitrogen gas can be positioned in one place in the lower portion of the chamber or then both in the upper and the lower portion of the chamber.

The nozzle dispersing the melt MgCl_2 - $\text{C}_2\text{H}_5\text{OH}$ complex can be any nozzle dispersing melt mass, e.g. a gas-liquid fluidisizing nozzle, an open or closed rotating nozzle or an ultrasound nozzle.

When the particulate carrier has been prepared, it is reacted with the transition metal compound and the optional electron donor to an olefin polymerizing procatalyst. It is preferable to react the carrier according to the present invention with TiCl_4 to produce an olefin polymerizing procatalyst. According to a furthermore preferable embodiment the carrier is reacted with TiCl_4 and an electron donor to produce an operating procatalyst.

Examples 1 to 4

Two 64kg and two 80kg portions of MgCl_2 were melted in a nitrified autoclave together with a corresponding amount of ethanol to produce a melt $\text{MgCl}_2 \cdot 3,5\text{C}_2\text{H}_5\text{OH}$ complex. The clear homogeneous mixture was achieved after an agitation of several hours at a temperature of +110°C. A chemical

analysis was carried out for the complex melt, the results of which are presented in Table 1.

Table 1 Chemical composition of complex melt

| Example | MgCl ₂ | EtOH | EtOH/MgCl ₂ |
|---------|-------------------|------|------------------------|
| | (kg) | (1) | (mole/mole) |
| 1 | 64 | 137 | 3,5 |
| 2 | 80 | 171 | 3,5 |
| 3 | 80 | 171 | 3,5 |
| 4 | 64 | 137 | 3,5 |

Then the clear homogenized mixture was heated from the temperature of +10°C to the temperature +125°C to achieve the C₂H₅OH removal effect. The heated melt was thereafter fed in the manner shown in figure 3 to the closed rotation nozzle 2 of the chamber and from there further dispersed in small droplets to the upper portion 3 of the chamber 1. The head of the nozzle was a disc rotating at a rate of 24,000rpm and the temperature of the upper portion of the chamber 1 was maintained at the temperature of +40°C by means of heated (heater 4) nitrogen gas 5 fed to the upper portion of the chamber and by means of cool nitrogen gas 7 fed to the middle and lower portion 6 of the chamber.

Thereafter the droplets, from which a part of the C₂H₅OH had been removed, was conducted to the lower portion 6 of the chamber 1, where they solidified to carrier particles due to the temperature +32°C regulated by the same means. Finally, the carrier particles were conducted out from the chamber 1 and were sieved in sieve 8, the size of the openings of which were 200µm, so that the particles penetrating the sieve 8 were used for the preparation of the procatalyst. All the time warm nitrogen gas was removed from the chamber, which gas was cooled down by the cooler 9 for reuse.

The chemical composition of the carrier obtained after the spraying was measured by determining its C_2H_5OH , Mg, and water content. The results are presented in Table 2.

Table 2 Chemical composition of the carrier

| Example | Mg | EtOH | H ₂ O |
|---------|-----|------|------------------|
| 1 | 9.6 | 58.4 | 0.6 |
| 2 | 9.6 | 58.2 | 0.7 |
| 3 | 9.6 | 60.2 | 0.6 |
| 4 | 9.4 | 57.6 | 0.5 |

The Mg content of the carriers according to the examples were almost the same i.e. 9.4 to 9.6% by weight. The C_2H_5OH content of three of the carriers was almost identical i.e. about 58% by weigh. The water content of all the carriers was about 0.6% by weight. As the very aim of the invention is a controlled removal of C_2H_5OH during the spraying, the molar ratio $C_2H_5OH/MgCl_2$ was also determined from the carrier product. The molar ratio mentioned, in melt and in the carrier obtained, is presented in table 3 and, moreover, the reduction in percentages of C_2H_5OH taking place in the spraying is presented.

Table 3 Evaporation of C_2H_5OH during the spraying

| Example | EtOH/ $MgCl_2$ | EtOH/ $MgCl_2$ | Vanish |
|---------|----------------|----------------|--------|
| 1 | 3.5 | 2.9 | 17.1 |
| 2 | 3.5 | 2.9 | 17.1 |
| 3 | 3.5 | 3.2 | 9.2 |
| 4 | 3.5 | 2.8 | 19.7 |

It turned out that in three of the cases (examples 1, 2, and 4) the desired reduction of C_2H_5OH had taken place and a carrier was obtained, the molar ratio $EtOH/MgCl_2$ of which was between 2.8 to 2.9. In the third example the evaporation was for some reason incomplete and a carrier was obtained,

the molar ratio EtOH/MgCl₂ of which was 3.2. In this case only 9.2% of the ethanol had left the complex, whereas in the successful experiments the removal percentage was between 17 and 20%.

Also the particle size distribution of the sprayed carrier was determined. The results are presented in Table 4.

Table 4 Particle size distribution of the carrier

| Example | D(0.1) μm | D(0.5) μm | D(0.9) μm | Span |
|---------|--------------|--------------|--------------|------|
| 1 | 29.4 | 94.8 | 354.5 | 3.43 |
| 2 | 23.9 | 100.5 | 295.2 | 2.70 |
| 3 | 10.3 | 45.4 | 135.3 | 2.76 |
| 4 | 40.0 | 113.5 | 272.4 | 2.05 |

As always, the particle size distribution curves shew that in the synthesis a fraction of particles of great size was created, but these proved to be agglomerates that always occur in connection with the measuring of particle size distribution. In other respects the particle size distribution was fully satisfactory. In the same connection an electron microscope picture was taken of the carrier product. It is presented in figure 4. The picture is very representative of the excellent level of morphology reached by the method according to the invention. When figures 4 and 2 are compared, it can be seen that the aims of the invention regarding the morphology have been reached.

Also an activation with TiCl₄ was carried out for the carriers and the copolymerization was carried out with the procatalysts thus obtained.

The activation was carried out so that a multioperation reactor furnished with a screen bottom, the volume of which was 1.5m³, was cooled to the temperature of about -20°C. Thereafter, hydrocarbon solvent (the Neste product LIAV),

carrier, and TiCl_4 were added to the reactor, in the order mentioned. The amount of carrier varied between 24 to 29kg and the molar ratio TiCl_4 /carrier $\text{C}_2\text{H}_5\text{OH}$ was about 10. The weight ratio LIAV/carrier was 9.0 and the molar ratio TiCl_4 /carrier was about 30. The reactor was mixed and the temperature was slowly raised to $+20^\circ\text{C}$. At this temperature di-isobutylene phthlate (DIPP) donor was added so that the molar ratio donor/Mg was 0.15. Then the temperature was raised to the value about 110°C and was maintained there for an hour, after which the activation residues together with the TiCl_4 excesses were removed by rinsing through the screen bottom. The second treatment with TiCl_4 was carried out by adding the reagent to the purified solid intermediary product. The temperature was still 110°C and the reaction time this time 2 hours. The molar ratio TiCl_4 /Mg was also now 30. Finally, the product was washed and dried by a nitrogen gas flow.

The procatalysts obtained through a reaction between MgCl_2 - $\text{C}_2\text{H}_5\text{OH}$ complex carrier and TiCl_4 were tested in the same polymerization conditions. A two-liter bank reactor was used. In each test polymerization run 20 to 30mg of procatalyst was used. $620\mu\text{l}$ of triethylaluminium cocatalyst and $200\mu\text{l}$ of 25% heptane solution of cyclohexylmethyl methoxy silane donor was mixed to this amount. The medium was 30ml of heptane. The polymerization was carried out at the temperature $+70^\circ\text{C}$ and the propene monomer pressure of 10 bars. The partial pressure of hydrogen during the polymerization was 0.2 bars. The polymerization was continued for 3 hours. Thereafter the activity of the procatalyst was measured on the basis of the polymerization yield. The soluble portion of the polymer was measured by dissolving a determined polymer amount into the solvent and measuring the evaporation residue of the pure solution.

The bulk density and the particle size distribution of all the polymer samples was determined. The total amount of the finely-divided material was determined in connection with the particle size distribution measurements. Hereby, all

polymer particles with a diameter less than 1mm were defined as finely-divided material.

5 The titanium content of the procatalysts obtained varied between 2.4 and 4.5% by weight while the donor content was varying between 9.7 and 15.4% by weight. The procatalyst yield was good, too, varying between 74 and 99%. The activity of the procatalysts was at its best 15.8kg of PP/g of cat., which is a good value and considerably better than
10 that of spray-dried catalysts.

15 The isotacticity of the polypropylene obtained with the procatalyst of the carrier according to the invention was between 96.8 and 97.5% (the index between 93.3 to 98.1) being at a satisfactory level. The polymer melt indices varied between 5.0 and 7.4 corresponding to the melt index of normal polypropylene. The bulk densities of the polymer varied between 0.40 and 0.44g/ml being at normal level, too. The particle size distribution was normal, too, and, in
20 particular, that of finely-divided material ($d < 1\text{mm}$) was enormously low i.e. below 10% by weight. It can thus be noticed that better results are obtained by the method according to the invention than by the conventional spray-drying or spray-crystallization.

Claims

1. A method for preparing a particulate carrier for an olefin polymerization procatalyst comprising a transition metal compound reacted for a carrier, in which method

a) a melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is provided containing in the average 3.3 to 5.5 $\text{C}_2\text{H}_5\text{OH}$ molecules as per each MgCl_2OH molecule,

b) the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is sprayed through a nozzle dispersing it into a chamber, wherein a carrier is formed of it, and

c) the particulate carrier is removed from the chamber, **characterized in that** during the stage b) so much $\text{C}_2\text{H}_5\text{OH}$ is removed from the $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex by the aid of heat that the particulate carrier obtained contains in the average 2.0 to 3.2 $\text{C}_2\text{H}_5\text{OH}$ molecules as per each MgCl_2 molecule.

2. Method according to Claim 1, **characterized in that** at stage a) is provided a melt containing at the average 3.5 to 4.0, preferably about 3.7 $\text{C}_2\text{H}_5\text{OH}$ molecules as per each MgCl_2 molecule.

3. Method according to claim 1 or 2, **characterized in that** during the stage b) so much $\text{C}_2\text{H}_5\text{OH}$ is removed from the $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex that the particulate carrier obtained will contain in the average 2.5 to 3.0 $\text{C}_2\text{H}_5\text{OH}$ molecules as per each MgCl_2 molecule.

4. Method according to claim 1, 2, or 3, **characterized in that** the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is sprayed in the upper portion of the chamber, where it is maintained at a temperature in which $\text{C}_2\text{H}_5\text{OH}$ is removed, and is then conducted in the lower portion of the chamber, where it is cooled to coagulate the complex melt containing less $\text{C}_2\text{H}_5\text{OH}$ to particulate carrier.

5. Method according to claim 4, **characterized in that** the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is maintained at a temperature, in which $\text{C}_2\text{H}_5\text{OH}$ is removed by spraying it into the upper

portion of the chamber heated essentially over its melting point and/or by maintaining in the upper portion of the chamber a higher temperature than in the lower portion of the chamber.

5 6. Method according to claim 5, **characterized in that** the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is sprayed in the upper portion of the chamber heated to a temperature of about +120 to +250°C.

10 7. Method according to claim 5 or 6, **characterized in that** in the upper portion of the chamber is maintained a temperature of +20 to +150°C, preferably +30 to +80°C, and in the lower portion of the chamber is maintained a temperature of -30 to +40°C, preferably -20 to +40°C, in anyway so that
15 the temperature of the lower portion is lower than that of the upper portion.

20 8. Method according to any of the claims 1 to 7, **characterized in that** the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is sprayed in the upper portion of the chamber heated to a temperature being over the melting point of the complex and higher than about +130°C (the temperature of the upper portion of the chamber).

25 9. Method according to any of the preceding claims, **characterized in that** the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is sprayed into the chamber by the aid of a hot nitrogen flow.

30 10. Method according to any of the preceding claims, **characterized in that** the temperatures of the upper and lower portions are maintained by the aid of one or several nitrogen gas flows.

35 11. Method according to any of the preceding claims, **characterized in that** the nozzle dispersing the melt $\text{MgCl}_2\text{-C}_2\text{H}_5\text{OH}$ complex is a gas-liquid-fluidisizing nozzle, a rotatable nozzle or an ultrasound nozzle.

12. Method according to any of the preceding claims, **characterized in that** the particulate carrier obtained is reacted with TiCl_4 and optionally with an electron donor to provide an olefin polymerization procatalyst.

5

13. Method according to any of the claims 1 to 11, **characterized in that** the particulate carrier obtained is reacted with TiCl_4 and with an electron donor to provide an olefin polymerization procatalyst.

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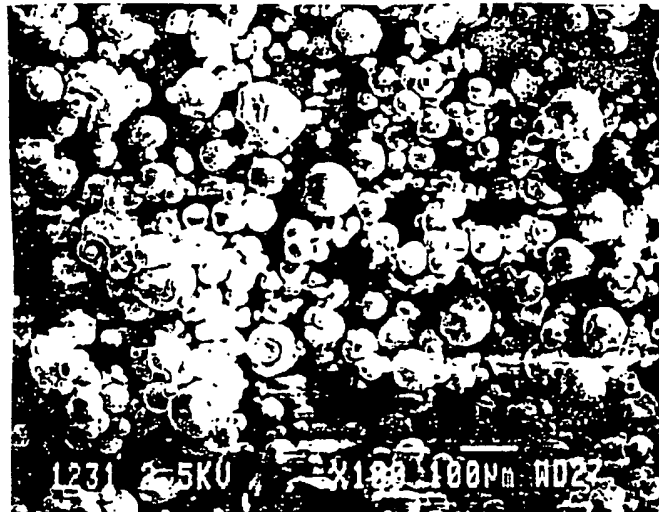


Fig. 1 Morphology of spray-dried carrier

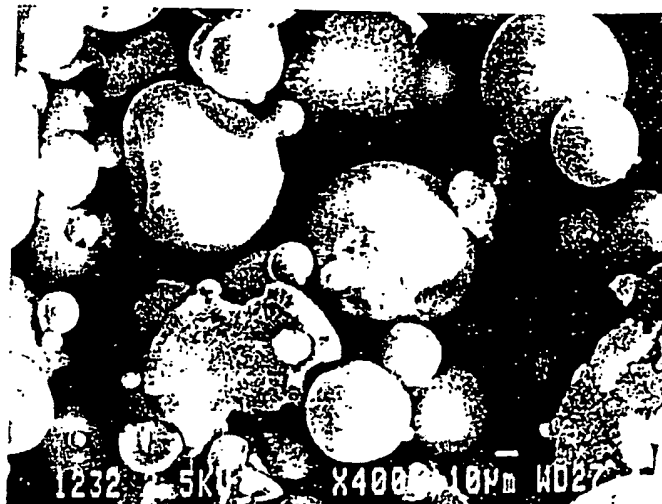


Fig. 2 Morphology of spray-dried carrier
(close-up)

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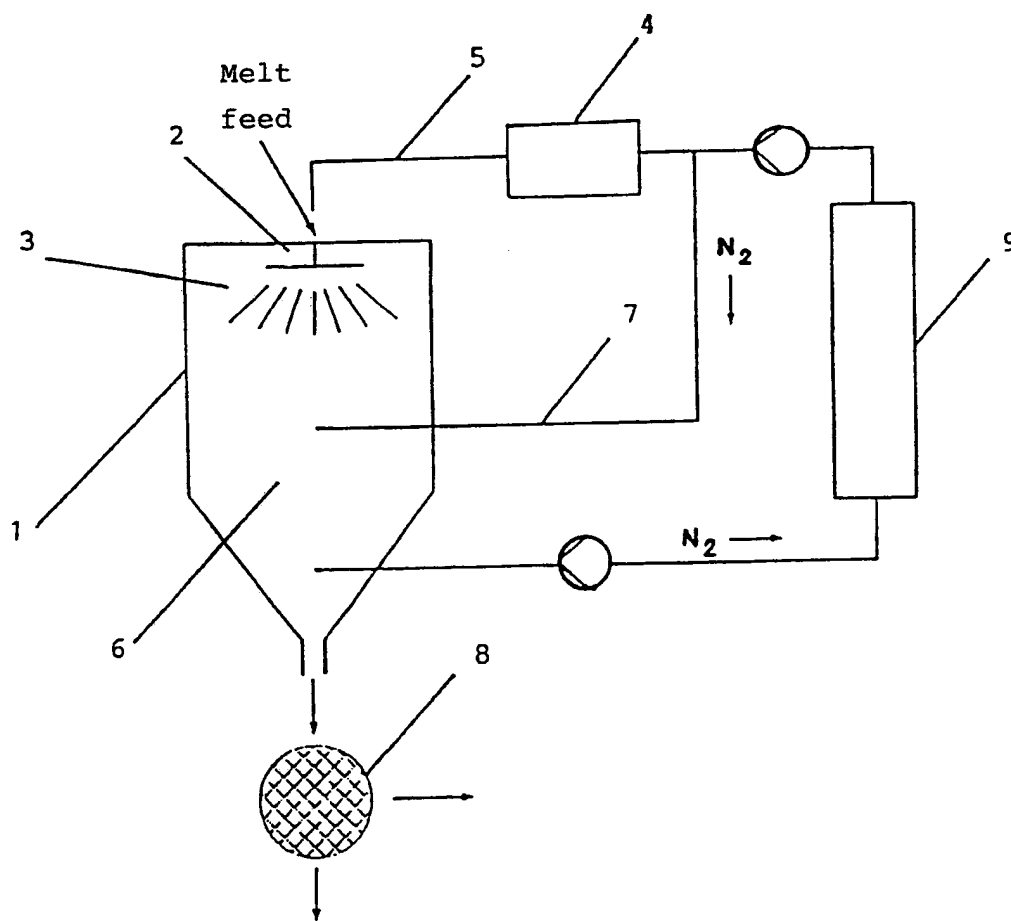


Fig. 3 Test equipment

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Fig. 4 Electron microscope picture of carrier

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 92/00324

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: C08F 4/02, C08F 4/654

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: C08F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| A | EP, A2, 0424049 (NESTE OY), 24 April 1991 (24.04.91) | 1 |
| | -- | |
| A | WO, A1, 8707620 (NESTE OY), 17 December 1987 (17.12.87) | 1 |
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Date of the actual completion of the international search

8 March 1993

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

29/01/93

International application No.
PCT/FI 92/00324

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| EP-A2- 0424049 | 24/04/91 | JP-A- 3151037 | 27/06/91 |
| WO-A1- 8707620 | 17/12/87 | CH-A,B- 671767 | 29/09/89 |
| | | DE-T- 3790287 | 23/06/88 |
| | | EP-A- 0279818 | 31/08/88 |

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